

Information

Guidelines for Discontinuing Cardiopulmonary Resuscitation in the Emergency Department After Prehospital, Nonparamedic-Directed Cardiac Arrest

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PREHOSPITAL CARDIOPULMONARY RESUSCITATION (CPR) is increasingly used to treat sudden cardiac arrest. Previous studies have suggested that more than 20% of patients in such circumstances can be successfully resuscitated.¹⁻⁶ A substantial percentage of the reported survivors who are resuscitated in the field and brought to hospital have intrinsic cardiac activity.¹⁻¹¹ The remaining patients, in whom field resuscitation attempts are unsuccessful, are brought to the emergency department for definitive therapy while still receiving active CPR. In this group, lengthy resuscitation is often attempted after arrival in the emergency department, although these patients are known to have a low probability of successful resuscitation and eventual hospital discharge.⁵⁻⁸

No accepted guidelines have been published that would enable physicians to decide when continued CPR in the emergency department is indicated or when it should be terminated. As a consequence, many victims of sudden death are undergoing expensive and unsuccessful attempts at CPR in the emergency department.

We analyzed 893 consecutive cases of prehospital resuscitation and conclude that the time from collapse to the initiation of CPR, the duration of active CPR and the cardiac rhythm on arrival can all be valuable discriminatory variables for predicting successful resuscitation in the emergency department. Attention to these factors can distinguish patients who should have aggressive CPR continued in the emergency department from those who will not benefit from such action.

Patients and Methods

A CPR training program has been in effect in Sacramento County (California) since 1976, and about 40,000 people each year have received basic CPR instruction from 1975 to

the present according to the records of the American Red Cross Association and the American Heart Association of Sacramento. However, names were not cross-referenced to determine whether a participant had taken a basic CPR class twice.

Sacramento County includes a suburban and rural population of 754,000 that is 72% white, predominantly working and middle-class and 18% of which is older than 55 years. All prehospital CPR attempts from July 1979 to June 1981 in the county of Sacramento were reviewed. The cases were retrieved from the emergency department and hospital records of eight hospitals and were cross-referenced with the reports of the emergency medical technicians responsible for delivering the patients to hospital. Patients requiring CPR due to major trauma were excluded.

The records of emergency medical technicians (EMT) levels I and II were included in the study. EMT I care predominated in the first six months of the study and was gradually replaced with EMT II services. About 40% of the patients in the present series were initially treated by EMT I personnel. EMT I personnel were trained in administering basic CPR with bag-mask ventilation and in transporting patients receiving CPR to the nearest hospital emergency department. EMT II rescuers were further trained to assess vital signs, do CPR, interpret electrocardiographic monitoring data, carry out defibrillation and administer drugs intravenously, including sodium bicarbonate, epinephrine, lidocaine and atropine. Furthermore, they were trained to support ventilation either by a bag-mask system or by insertion of an esophageal obturator airway. EMT II personnel received remote voice direction from physicians based in predesignated emergency departments throughout the country. When indicated, defibrillation was done with either 200 or 300 joules per second. Mechanical assistance devices as a form of CPR were not used in this study.

In the sequence of resuscitation directed by a hospital-based physician, the EMT II personnel were ordered to establish an airway, insert an intravenous line and administer sodium bicarbonate and epinephrine before defibrillation if the cardiac arrest occurred before their arrival. If the arrest was witnessed by the EMT II rescuers, then immediate defibrillation was ordered. If defibrillation was successful, patients were further stabilized at the scene and then transported to hospital for definitive treatment and evaluation. When unsuccessful, CPR was continued during transport to hospital for further resuscitation or pronouncement of death.

For this study, successful resuscitation was defined as discharge from hospital of a patient who had had a documented prehospital cardiac arrest. Hospital course complications were ascertained from a review of hospital records. Neurologic impairment was considered severe when it necessitated total care or when it severely restricted independent function. Patients were judged as having no neurologic impairment when they could return to their prior way of life.

Patients with both witnessed and unwitnessed cardiac ar-

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ABBREVIATIONS USED IN TEXT

CPR = cardiopulmonary resuscitation
EMT = emergency medical technician

rest were included in the study. A witnessed arrest was defined as an arrest observed either by sight or by an observer hearing the fall of the person. The time from arrest to initiation of CPR either by a lay bystander or by EMT personnel was recorded as estimated time between collapse and the initiation of CPR, except when they observed the arrest and began CPR immediately. Duration of prehospital CPR was defined and recorded by the rescuers as the time from the initiation of CPR until arrival at the emergency department. If resuscitation was successful at the scene (the patient had spontaneous pulse and cardiac activity), the duration of prehospital CPR was defined as the interval between initial cardiac arrest and cessation of manual CPR. The cardiac rhythm on arrival at the emergency department was obtained by review of the physician charts and nurses' notes. Most patients had sample rhythm strips in the charts, and these were verified by the authors against the stated impression. For 112 patients, none of whom survived, an adequate record of their cardiac rhythms on arrival at the emergency department could not be verified.

Results

During the study period, 893 patients with nontraumatic cardiac arrest were identified, 29 (3.2%) of whom survived long term (Figure 1). Of these, 20 (69.0%) were successfully resuscitated before arrival at the hospital and were eventually discharged. Only nine (31.0%) of the long-term survivors were undergoing active CPR on arrival at the emergency department. Five of the nine patients were resuscitated by EMT I personnel, whereas the other four were treated by EMT II personnel. Two of the nine patients had initial successful resuscitation and had been transported to the emergency department without active CPR but subsequently suffered a second cardiac arrest within three minutes of arrival. Seven patients (0.8%) were resuscitated on arrival at the emergency department after unsuccessful prehospital CPR. All these patients had ventricular fibrillation confirmed by electrocardiographic records.

A total of 79 patients (8.8%) was admitted to hospital, but 50 (63.3%) patients died during hospital stay. In all, 814 patients (90.9%) were declared dead in the emergency department after unsuccessful CPR. Of the 29 survivors, 5 (17%) suffered a severe neurologic deficit and required permanent institutional care. Only 24 of 893 patients (2.7%) resumed their prior activities when discharged from hospital.

The cardiac rhythms for all patients on arrival at the emergency department are shown in Figure 2. Asystole was the predominant rhythm, observed in 372 patients (47.6%) of the verifiable cases (N = 781). Asystole and bradyarrhythmias (agonal, idioventricular and electromechanical dissociation) were present in 511 patients (65.4%), 1 of whom survived. The cardiac rhythms for long-term survivors are also shown in Figure 2. A supraventricular rhythm, defined as atrioventricular conduction with a ventricular response, was present in 35 patients, 18 (51.4%) of whom were long-term survivors. These patients had spontaneous cardiac activity and

were not receiving CPR. One patient (5.8%) of those with ventricular tachycardia and one patient (3%) of those with an idioventricular rhythm survived; however, each of these patients arrived with a palpable pulse and inherent cardiac activity. No patient with asystole or a bradyarrhythmia who arrived receiving active CPR survived. Nine patients (4.2%) of those with ventricular fibrillation were resuscitated.

The duration of prehospital CPR for patients resuscitated in the emergency department is shown in Table 1. Of the patients who had prehospital CPR for more than 30 minutes (34 minutes), only one survived. In another case, it was impossible to determine the exact duration of prehospital CPR, but that patient did not receive prolonged prehospital resuscitative efforts and was transported to the hospital quickly. The mean duration of prehospital CPR (under EMT II care) in our study was about 32 minutes.

The periods from cardiac arrest to the initiation of CPR for those patients who died in the emergency department are shown in Figure 3. The majority of arrests, occurring in 628 patients (70.3%), were unwitnessed or were associated with CPR done after more than five minutes had elapsed (Figure

TABLE 1.—Duration of Prehospital CPR for Patients Resuscitated in the Emergency Department

Time (min)	Survivors (N)
1-10	4
10-20	2
20-30	1
30-35	1
Unknown	1

CPR = cardiopulmonary resuscitation

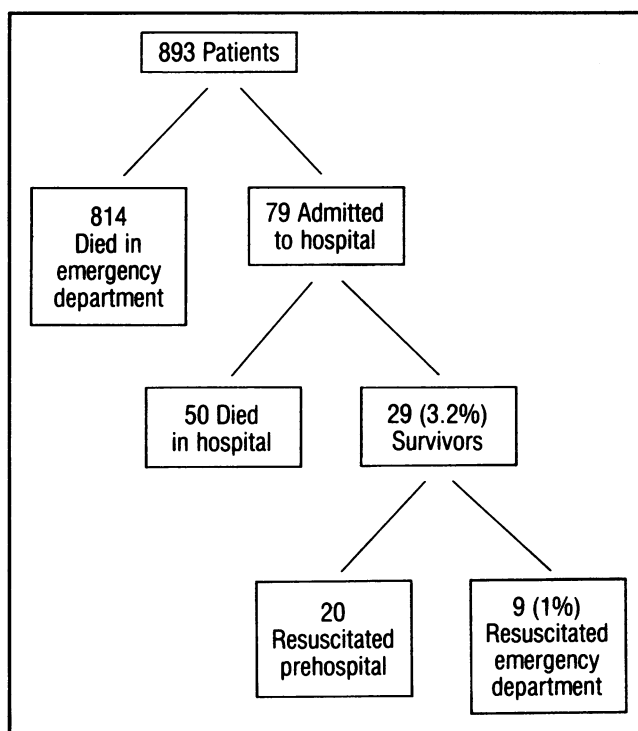


Figure 1.—Summary of nontraumatic cardiac arrest episodes in 893 patients.

4). Of the survivors resuscitated in the emergency department, all but one had witnessed arrests and had CPR initiated within five minutes after collapse. The only survivor of an unwitnessed arrest (who was resuscitated in the emergency department) suffered extensive neurologic injury resulting in only midbrain function at one-year follow-up.

Successful resuscitation before arrival at the hospital was unrelated to the age of the patients, except that no patient older than 84 years was resuscitated at the scene. No patient older than 77 years was successfully resuscitated in the emergency department; 180 patients (20.2%) were older than 75 years. Conversely, no patient younger than 20 years was resuscitated; 52 patients (5.8%) were younger than 20.

Comment

Viability after cardiac arrest is associated with the rapid initiation of CPR and the early institution of defibrillation. Previous reports have emphasized that CPR must be initiated within four minutes of collapse and defibrillation must be accomplished within eight minutes to achieve reasonable success.^{1-5,9} Any delay greatly increases the risk of death. Since 1970, many communities have begun EMT and paramedic programs, and training lay personnel in CPR techniques has been enthusiastically attempted. However, the crucial variable—a trained, responsive population—has been more difficult to achieve.¹⁰ As a consequence, many of the victims of

sudden death have CPR initiated only after a considerable delay. Many patients who might possibly benefit from CPR must await the arrival of trained professional rescuers, and most are brought to hospital in a physiologic state not conducive to resuscitation.¹⁻⁸ Although guidelines have been proposed, none are currently accepted that would enable an attending physician to distinguish patients who might benefit from continued CPR from those who are clinically dead on arrival.¹¹ CPR as currently practiced within emergency departments is costly, and the technique should be applied in a rational manner.

Patients who were successfully resuscitated in our series had characteristics similar to patients rescued in other studies. They had prompt institution of CPR and early definitive care; more important, they had a rhythm amenable to defibrilla-

All Patients

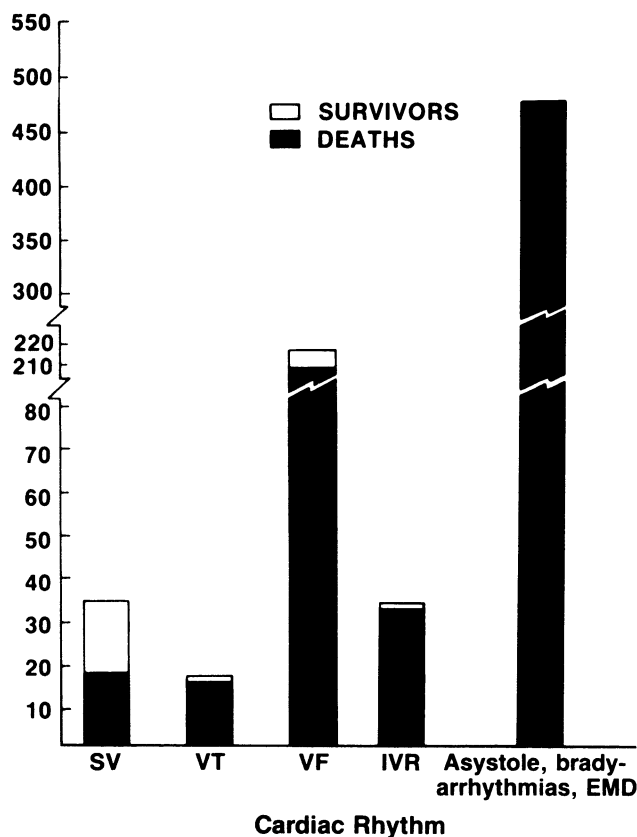


Figure 2.—Cardiac rhythms for all patients arriving at emergency department after prehospital cardiopulmonary resuscitation. SV = supraventricular rhythm with spontaneous cardiac activity, VT = ventricular tachycardia, VF = ventricular fibrillation, IVR = idioventricular rhythm, EMD = electromechanical dissociation

Died in Emergency Department

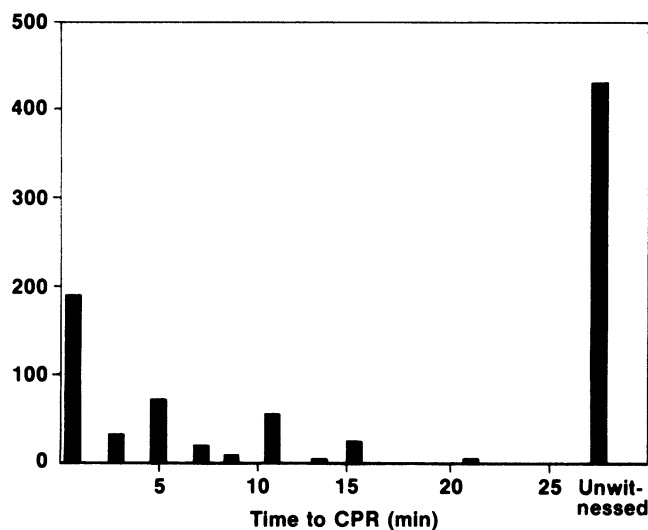


Figure 3.—Time from collapse until initiation of cardiopulmonary resuscitation (CPR).

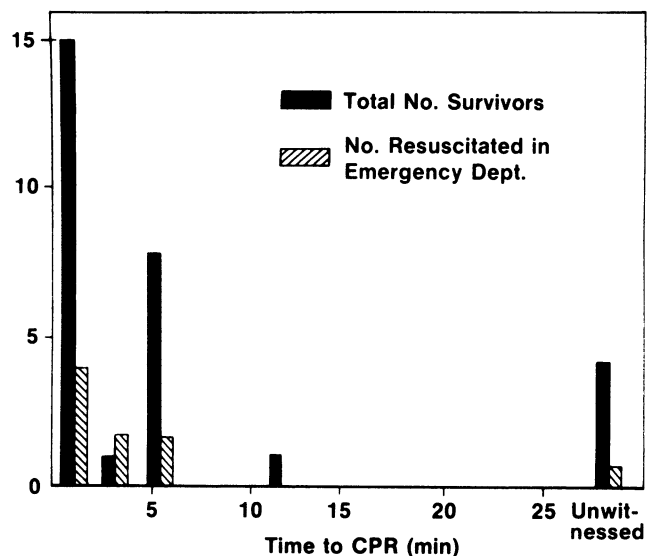


Figure 4.—Time from collapse until initiation of cardiopulmonary resuscitation (CPR) for patients resuscitated at scene of cardiac arrest and for those resuscitated in emergency department.

tion—ventricular fibrillation, ventricular tachycardia or both.⁹

Those who did not survive in this series had distinct characteristics as well. The initiation of CPR was delayed and CPR was prolonged. In addition, their cardiac rhythms were those characteristically not amenable to defibrillation.¹⁻³ The first cardiac rhythm recorded in the hospital after unsuccessful prehospital CPR discriminated between survivors and nonsurvivors. All survivors resuscitated in the emergency department had ventricular fibrillation on arrival at the hospital. Nearly 70% of the patients were asystolic or had a bradyarrhythmia without an associated pulse when they arrived at the emergency department. Previous studies in which the initial rhythm at the scene of cardiac arrest has been analyzed have confirmed a poor success rate in patients with asystole or bradyarrhythmic patterns.¹⁻³

Analysis of the cardiac rhythm on arrival at the emergency department after an extensive attempt at prehospital CPR distinguishes our study from previous series. Asystole or bradyarrhythmias are an ominous sign, and current therapeutic techniques do not appear useful in reviving these patients.

An unwitnessed cardiac arrest is associated with a high mortality rate also.² In our series, an unwitnessed arrest occurred in most patients, only five of whom survived, four who were resuscitated before they arrived at the hospital. Of nine survivors who required hospital resuscitation, an unwitnessed arrest occurred in only one, who did not receive extensive prehospital care but was promptly transported to hospital. Thus, patients with an unwitnessed arrest who are not resuscitated at the scene constitute an apparently unsalvageable group. Patients with an unwitnessed arrest who did not respond to the initial resuscitation could not be revived in the emergency department.

The duration of prehospital CPR required also correlated with survival. Only one patient was resuscitated after 30 minutes of CPR at the scene of the cardiac arrest. CPR, which at best achieves 35% of normal blood flow, appears to be decreasingly effective with time.¹²⁻¹⁶ CPR administered in the street or in the back of a moving ambulance is even less effective in supporting circulation. The duration of prehospital CPR appears to be inversely proportional to the chance of survival.

Although the poor results from this study have several causes, two technical factors probably contributed to the outcome. Successful prehospital resuscitation requires adequate prehospital ventilatory management. In most series of reported success with prehospital CPR, endotracheal intubation has been the ventilatory method used. Many communities, however, do not use this technique. In our series, the esophageal obturator airway was used, a device that has not been shown to provide adequate ventilation.¹⁷ Thus, we could not ensure optimum prehospital ventilation for our victims of cardiac arrest, and our results may reflect this fact.

Second, early defibrillation was not universally applied in our series. Previous reports^{2,3} have shown the necessity, to ensure successful prehospital CPR, of promptly defibrillating, when appropriate.

On the basis of our data, however, certain criteria can be established to determine the necessity for continued CPR by

emergency department personnel for victims of prehospital cardiac arrest. These criteria would apply in communities not serviced by paramedics or when paramedics do not have the option of inserting an endotracheal tube in prehospital resuscitative efforts to revive patients who are not hypothermic or victims of cold water drowning.

In an unwitnessed arrest, when asystole or a bradyarrhythmia not associated with spontaneous cardiac activity is noted and when the patient has had the benefit of EMT II or paramedic-directed CPR efforts at the scene, no further action is deemed necessary.

These guidelines would reduce hospital-based CPR attempts more than half, in our experience, without jeopardizing any potentially salvageable patient. All patients could be rapidly classified from information obtained from the rescuers on arrival at the emergency department and from an electrocardiogram.

Conclusion

Rigorous CPR should be done in the following circumstances: when CPR has been initiated promptly after collapse, when there has been no attempt at prehospital defibrillation or definitive resuscitation and when the patient has a rhythm amenable to defibrillation (ventricular tachycardia or ventricular fibrillation).

Prolonged CPR is almost invariably futile. As a nation, we have devoted time and resources to improving cardiopulmonary resuscitation; we need to recognize its limitations.

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